ABSTRACTS FROM ASTRONOMICAL PUBLICATIONS.

The Principal Series of Sodium.

The principal series in the spectrum of sodium consisting of the D lines and the ultra-violet lines at wave-lengths 3302, 2853, 2680, 2594, 2544 and 2512 have been known for some time in emission spectra obtained in the laboratory. In 1908, Professor R. W. Wood from a study of the ultra-violet absorption spectrum of sodium was able to extend the members of this series to forty-eight, a greater number than that found even in the case of chromospheric or stellar hydrogen.

A very interesting paper by R. W. Wood and R. Fortrat under the above title in the January, 1916, number of the *Astrophysical Journal* gives the results of a repetition of this work made in the laboratory of Professor Weiss at Zurich. The quartz spectrograph employed by them consists of six 60° and one 30° quartz prisms (the latter backed by mercury), giving by double transmission the equivalent of thirteen prisms. This instrument, the most powerful quartz spectrograph in the world, will resolve, at λ 2414, two lines which differ in wave-length only .03 A and gives a linear dispersion of 1 A to 3.5^{mm}.

The results set forth in the present paper may be briefly summarized as follows: (a) Ten new lines near the head of the series have been added, making the number thus far observed in the principal series of sodium fifty-eight. This in their opinion marks the limit which is at present attainable. (b) Of the original seven members, only the first three had previously been resolved into doublets. In the present investigation they were able to resolve the other four members and to determine the wave-lengths of the components. (c) The wave-lengths of all of the lines of the series have been determined to the third place of decimals, and referred to the secondary standards of Fabry and Buisson. (d) The well-known formula of Ritz for the lines of the principal series of an element represents with a surprising degree of accuracy

all of the lines of the series obtained by them. (e) They have photographed all of the absorption lines of the principal series of sodium up to a point within 1.21 A of the calculated head of the series.

The method of studying by means of the absorption spectrum the higher members of a series, not appearing in emission spectra, to which Professor Wood first called attention, is one which will undoubtedly prove of great value in further studies of series relations in spectra.

J. H. Moore.

Note on Störmer's Aurora Observations.

Professor Störmer of the University of Christiania has published some extremely interesting and important results of his expedition to northern Norway, in the spring of 1913, for the purpose of observing the auroræ. He and an assistant observer occupied two stations, respectively, one at Bossekop and the other at Store Korsnes, separated by a distance of 27.5 kilometers. The two observers were armed with suitable photographic equipment in duplicate, and a telephone line connected them constantly. The auroræ were plentiful and bright, and the observers were able to agree by telephone upon the auroral structure to be photographed simultaneously. By virtue of their different positions with reference to the auroræ, the backgrounds of stars recorded on the simultaneous photographs were differently placed with reference to the auroral structure. Measures of this structure, with reference to the star images on the plates, gave accurate values of the parallaxes of the auroræ, from which their accurate distances from the two observers and from the Earth's surface could be computed.

The results thus far published are for the nights March 3-4, 4-5, and 11-12, 1913. Several hundred measures of auroral altitudes are amongst the results. The very great majority of the auroræ were from 95 to 125 kilometers above the Earth's surface. The preferential altitude was between 95 and 115 kilometers, with a well-defined maximum of preference at almost exactly 100 kilometers. There were no observed altitudes less than 89 kilometers,

and only a few greater than 160 kilometers, tho some extended up to 220 kilometers.

The forms and positions of some of the "curtains" of auroral structure were well determined.

Professor Störmer is making a thoro study of the phenomenon of the auroræ on the basis of his observations. He provisionally assigns the origin of auroræ to positively charged electric particles expelled from the Sun and driven into the Earth's higher atmosphere, but he thinks it best to wait until all of the observations have been studied before stating his theory of the auroræ more definitely.

W. W. CAMPBELL.

PTOLEMY'S CATALOG OF STARS.

The Carnegie Institution of Washington has published, with the above title, a revision of the *Almagest* of Ptolemy; or rather that part of the *Almagest* which contains the catalog of 1028 stars, the earliest known list of the measured positions of the brighter stars. The revision was done mainly by Dr. C. H. F. Peters, as a labor of love, but was not completed by him at the time of his death in 1890. Meantime, Mr. E. B. Knobel, formerly president of the Royal Astronomical Society, had undertaken a revision of the manuscripts existing in the famous storehouses of literary antiquities at the British Museum, and at Oxford; and when he discovered that Dr. Peters had been searching the libraries of the European capitals for the purpose of collating the various manuscripts that were in existence, he suggested a combination of their labors, which seems to have been carried out in a most harmonious spirit. After the death of Dr. Peters, Mr. Knobel took charge of all the notes, and encouraged by Prof. Simon Newcomb and various other astronomers, and by public-spirited citizens of this country, the work was put in the form of the publication issued by the Carnegie Institution.

The places of Ptolemy's Catalog are given in celestial latitude and longitude, and the brightness of the stars was recorded on a scale which differs but slightly from the modern photometric scale

of magnitudes. No original manuscript is in existence, as far as known, but some twenty-six copies have been consulted in the endeavor to produce a correct list. The latitudes and longitudes were given, nominally, for the epoch A. D. 138, but the computation of the effects of precession shows that the positions are more nearly exact for an epoch about eighty years earlier; and they then correspond with the positions of the stars at the time of Hipparchus, 130 B. C., corrected uniformly by a change of 2° 40′ in longitude, for the effect of precession. In fact it has always been a matter of doubt whether Ptolemy made any actual observations of the places of the stars, since it seems most likely that he simply reproduced the earlier list of Hipparchus, with the corrected longitudes.

The earliest copies that were made were in the Greek, and date from the ninth century. Other copies, in Arabic, are in existence, which appeared to have been derived from original sources. The Latin manuscripts, thus far known, are probably copies of either one of the above. In the copying, performed often evidently by scribes not well informed in the subject, many errors were introduced, due to their ignorance; and besides this difficulty, many errors can be traced to the confusion of the symbols denoting fractions, and even whole numbers. The measures were recorded in fractions of a degree, and it is needless to remark how coarse such measures would appear in comparison with those made by telescopes and modern instruments of precision, where we deal with fractions of a second of arc. For the purpose of recording changes in the sky, the appearance of new stars, or the disappearance of old, the possible movements of the stars, and the transformation of their relative positions due to the precession, the ancient catalog fulfilled a purpose. It is certainly a pleasure to astronomers to see the careful and extensive work done on the revision thus fully recognized by publication.

Dr. Peters came to the old Dudley Observatory at Albany, under Dr. B. A. Gould, and later was for thirty years Director of the observatory at Hamilton College, Clinton, N. Y. His discoveries of asteroids made him famous, in the days when the labor of comparing these faint objects with the sky direct was vastly greater than that involved now in the comparison of photographs of the

sky. His charts of faint stars, made in this search, are still in use. And his comet discoveries gave him also some fleeting renown. He was a man of simple manners, a bachelor all his days, genial to his associates but modestly averse to outside intercourse, and his culture outside of scientific lines was also notable. He is credited with the knowledge of Greek, Latin, Hebrew, Arabic, Persian and Turkish, besides the acquaintance with many European languages that was a part of the education of men of the old school.

R. H. TUCKER.

"COMET-SEEKING AND COMET-SEEKERS."

In an article with this title, published in the *Journal of the British Astronomical Association* for December, 1915, Mr. W. F. Denning gives three tables which form an excellent summary of cometary discoveries and discoverers of modern times.

The first table shows "the leading finders of comets during the last 150 years," and includes the names of all who have found five or more comets, counting, however, "only those for which orbits were computed, and in reference to which absolute priority could be claimed." The table contains eighteen names. J. L. Pons (1802-1827) leads with 28 discoveries, but is closely followed by W. R. Brooks (1883-1911) with 25 and E. E. Barnard (1881-1915) with 22. Two other American astronomers are conspicuous on the list, Lewis Swift (1862-1899) with 12 comets, and C. D. Perrine (1895-1899) with 13 comets.

The second table shows the monthly discoveries for the past 123 years (1782-1914), doubtful objects again excluded. July and August appear to be the most favorable months for such discoveries, and it is interesting to note that the latter half of the year is more fruitful than the early half, the numbers being, respectively, 242 and 171.

The third table shows the annual rate of discoveries, grouped in twenty-year intervals from 1782 to 1901, and a thirteen-year in-

terval (1901-1914). The annual average has risen from 1.25 in the first interval to 5.00 in the last. The record year was 1898 with ten discoveries, and 1876 and 1872 were the only barren years.

Mr. Denning comments on the work necessary to find a comet, on its fascination and on its promise of success. His arguments are addressed mainly to English amateurs, but have equal point for amateurs in America.

R. G. AITKEN.

ON THE CALCULATION OF SERIES IN SPECTRA. BY H. G. SAVIDGE AND PROF. J. W. NICHOLSON. PHIL. MAG. **30**, 563, 1915.
NOTE ON THE CALCULATION OF SERIES IN SPECTRA.
BY W. M. HICKS, F. R. S., IBID, **30**, 734, 1915.

These papers have to do with numerical tests to be applied to the wave numbers of lines suspected of being members of a spectral series. To sort out from an apparently heterogeneous group of lines a number which will satisfy relations consistent with formulæ believed to be general in their application to spectral series is, in general, a difficult task, in the absence, at any rate, of distinguishing physical characteristics which may be peculiar to members of such a series. The methods described by the authors of these articles will undoubtedly prove of great assistance to any one attempting to establish series relations in laboratory or celestial spectra.

W. H. WRIGHT.